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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/674,631	09/29/2003	Shashank C. Deshmukh	8233/ETCH/SILICON/JB	4703

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EXAMINER

UMEZ ERONINI, LYNETTE T

ART UNIT PAPER NUMBER

1765

DATE MAILED: 12/14/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/674,631

Applicant(s)

DESHMUKH ET AL.

Examiner

Lynette T. Umez-Eronini

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 04 October 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-41 is/are pending in the application.
- 4a) Of the above claim(s) 22-41 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-21 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☒ Claim(s) 22-41 are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 29 September 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>1/15/2004</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of claims 1-21 in the reply filed on 10/4/2005 is acknowledged.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1-4 and 5-11 are rejected under 35 U.S.C. 102(b) as being anticipated by Grimbergen et al. (US 6,406,924 B1).

Grimbergen teaches an etching endpoint detection method during processing of a substrate (column 2, lines 62-65 and column 5, lines 41-41-43). The method comprises the steps of placing a substrate in a chamber to etch a layer on a substrate (column 3, lines 39-42); emitting radiation having a wavelength that is absorbed in a predetermined path length in a thickness of a layer on the substrate, using a radiation detector to detect radiation and generate a signal, and using a computer readable program to detect a change in the signal to determine the endpoint of the process (column 3, lines 49-61). Grimbergen further discloses an etching endpoint method by measuring change in intensity of reflected radiation as a function of etching time (column 20, lines 24-29). The aforementioned reads on,

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A method for determining the endpoint of an etch process, comprising:

- (a) providing a substrate comprising a material layer having a thickness;
- (b) etching the material layer on the substrate;
- (c) directing radiation onto the substrate as the material layer is etched, where the radiation has a wavelength that is on the order of the thickness of the material layer;
- (d) measuring a change in intensity for radiation reflected from the substrate at a pre-selected wavelength as the material layer is etched; and
- (e) terminating the etch step upon measuring a predetermined metric for the change in intensity of radiation reflected from the substrate at the pre-selected wavelength, **in claim 1**; and

A method for determining the endpoint for etching a gate dielectric layer of a transistor (column 9, lines 56-57), comprising the steps as recited **in claim 11**.

Grimbergen also teaches,

wherein the radiation has a wavelength, which lies within a range from about 200 to 800 nm onto the substrate (column 6, lines 36-49), **in claim 2**;

wherein the thickness of the material layer is 5 to 300 Angstroms, **in claim 3** (column 12, lines 14-18);

wherein the thickness of the material layer is less than or equal to the wavelength (column 12, lines 14-18), **in claim 4**;

wherein step (d) comprises: filtering wavelengths other than the pre-selected wavelength (column 7, line 61 column 8, line 14), **in claim 6**;

wherein the predetermined metric is associated with measuring a predetermined change in intensity for the reflected radiation at the pre-selected wavelength (column 8, lines 15-15-18), **in claim 7**;

wherein the predetermined metric is associated with measuring a substantially constant intensity for the reflected radiation as a function of time at the pre-selected wavelength (column 20, lines 24-29), **in claim 8**; and

wherein measuring the predetermined change of intensity for the reflected radiation is associated with removal of the material layer from the substrate (column 8, lines 15-15-18), **in claim 9**.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to

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consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Grimbergen (US '924 B1) as applied to claim 1 above, and further in view of Perry et al. (US 6,160,621).

Grimbergen differs in failing to teach wherein step (c) comprises: directing the radiation substantially perpendicular to the material layer; and modulating the intensity of the directed radiation.

Perry teaches an interferometric method for in-situ monitoring of a thin film thickness of etch rates using a pulsed flash lamp (Abstract), which has a wide spectral width (column 3, lines 19-23). Perry also teaches, collimated optical radiation is incident normally to the wafer (claim 3), which reads on, directing the radiation substantially perpendicular to the material layer; and modulating the intensity of the directed radiation.

However, Perry illustrates directing radiation perpendicular to the material and modulating the intensity of the directed radiation is known. Hence, it would have been obvious to one having ordinary skill in the art at the time the invention was made to use Perry's method of pulsating radiation on a wafer for the purpose of monitoring a plasma etch process that provides an interferometric signal having a broad spectral over conventional methods, which use extended broadband light sources that suffer from problems of low signal to noise ratio and low intensity interferometric signals (Perry, column 2, lines 37-53 and column 3, lines 8-11).

Claim Rejections - 35 USC § 103

7. Claims 11-15 and 17-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Litvak et al. (US 5,414,504) in view of Ngai et al. (US 6,518,106 B2).

As to claims 11, 12, 14, 15, and 17-21, Litvak discloses, “. . . a semiconductor wafer, consisting of a silicon substrate with a thin (approximately 500 nm) film of Silicon dioxide covered by a photoresist mask with approximately 2-3% exposed area is etched in a plasma etcher, for the purpose of making small contact holes in the Silicon dioxide film. The light emitted from the plasma etcher during the etch is observed by an endpoint controller device, such as the Xnix Model 1200, having the capability of observing multiple wavelengths. One wavelength of light, viz. 483 nm, ("Channel A") corresponding to an optical emission band of the molecule CO, is observed to detect the process endpoint, the point in time at which the exposed Silicon dioxide film has been etched away and the etch has reached the substrate . . .” (column 7, lines 4-25).

Litvak differs in failing to teach a gate dielectric layer of a transistor, **in claims 11, 12, 14, 15, and 17-21**; and wherein the gate dielectric layer comprises at least one film of hafnium dioxide (HfO₂) and hafnium silicate (HfSiO₂), **in claim 13**.

Ngai teaches forming gate dielectric over a semiconductor substrate in forming transistors and the gate dielectric is SiO₂ or can be an oxide such as HfO₂ (column 2, lines 34-56).

However, Ngai illustrates using SiO₂ and HfO₂ as gate dielectric is known.

Hence, it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to use SiO₂ and to select HfO₂ as a gate dielectric as

taught in the Ngai reference because their use are known in manufacturing of semiconductor of semiconductor devices.

8. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Litvak et al. (US '504) in view of Ngai et al. (US '106 B) as applied to claim 11 above, and further in view of Perry et al. (US 6,160,621).

Litvak in view of Ngai differ in failing to teach wherein step (c) comprises: directing the radiation substantially perpendicular to the material layer; and modulating the intensity of the directed radiation.

Perry teaches an interferometric method for in-situ monitoring of a thin film thickness of etch rates using a pulsed flash lamp (Abstract), which has a wide spectral width (column 3, lines 19-23). Perry also teaches, the collimated optical radiation is incident normally to the wafer (claim 3), which reads on, directing the radiation substantially perpendicular to the material layer; and modulating the intensity of the directed radiation.

However, Perry illustrates directing radiation perpendicular to the material and modulating the intensity of the directed radiation is known. Hence, it would have been obvious to one having ordinary skill in the art at the time the invention was made to use Perry's method of pulsating radiation on a wafer for the purpose of monitoring a plasma etch process that provides an interferometric signal having a broad spectral over conventional methods, which use extended broadband light sources that suffer from problems of low signal to noise ratio and low intensity interferometric signals (Perry, column 2, lines 37-53 and column 3, lines 8-11).

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynette T. Umez-Eronini whose telephone number is 571-272-1470. The examiner is normally unavailable on the First Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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December 8, 2005

NADINE G. NORTON
SUPERVISORY PATENT EXAMINER
